

## ENGINEERING CHEMISTRY

	Water-tube Boiler, Silvertown.	Water-tube Boiler, London, E.	Water-tube Boiler, Bermondsey.	Steamer Water-tube Boiler.	Steamer Water-tube Boiler.	Only Scale from Water-tube Boiler.
Moisture	Q-65%	1-42%	0-70%	i-i5%	0-36%	—
Combined water and lime	—	5-02	5-70	—	—	4-82%
Silica	5-56	6-17	5-30	0-04	0-30	2-30
Oxide of iron and	2-16	0-10	7-00	20-25	12-00	0-62
Lime (CaO)	47-14	30-57	27-16	20-24	24-10	24-72
Magnesia (MgO)	4-29	3-59	1-60	3-20	2-21	1-11
Sulphuric	17-02	14-68	0-07	20-50	46-65	—
Chlorine	—	—	—	0-72	—	—
Carbon dioxide	22-02	19-85	28-09	0-02	3-17	27-16
Oil	100-03	100-00	88-40	100-00	100-07	80-04
	—	—	11-60	—	—	19-96
			100-00			100-00

hydrochloric acid is set free. Ordinarily the ill effects that might be expected to result from this reaction are prevented largely or altogether by the presence of carbonate of lime and carbonate of magnesia which neutralize the acid. On the other hand there is reason to believe that, in conjunction with oxygen in the feed-water, magnesium chloride is a markedly corrosive agent, and very rapid destruction of plates and fittings of boilers at sea has been noticed which appeared traceable to their joint action. Very soft waters, if containing carbonic acid and oxygen in quantity, manifest corrosive action which shows itself particularly about the water-level. A small addition of lime shell in such cases is efficacious. Where canal or river water in industrial areas is used for feed, the possibility of discharges of acid liquors into the supply must be kept in view, and even collected rain-water in such neighbourhoods is liable to show traces of sulphuric acid derived from the atmosphere.

**Purification of Feed-water.**—If chemically pure water were obtainable in quantity this would be the ideal for steam-raising. In practice the nearest approach to it is got by taking the condensed steam from surface condensers and returning it to the boilers. Certain risks attend this operation and must be guarded against, notably the contamination of the condensate with oil and the presence in it of excessive quantities of carbonic acid and air. The admission of the water used for cooling must also be prevented as far as possible, more especially if this is sea or dirty river water. For the latter purpose salinity indicators are used—a specialized form of hydrometer either of glass or metal—or, for more accurate observation, a

standard solution of silver nitrate with chromate of potash indicator. To make up the unavoidable shortage it is always necessary to supplement the boiler supply from outside, and for this recourse must be had to a natural water. If such is available containing only a few grains of hardness per gallon it may be used directly, but if only a hard water is to be had, this should be treated for removal of the hardness before admission to the boiler. The extended use of water-tube boilers working at high pressures in present-day practice involves a corresponding employment of artificially purified water.